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THE EFFECT OF RAIN ON EARTH-WORMS.¹

DURING the rain in Washington, D. C., on the 20th of March, my attention was attracted to the earth-worms so abundant on the paths, the sidewalks and the streets of the city. They seemed to be everywhere. Some were large, some small ; some active, some sluggish ; some alive, many dead. I had noticed their presence before during January and February in the Capitol grounds, especially on the pavements. I supposed then they had simply come out from under some rubbish lying along the sides of the walks, and that they would straggle back again. I have since come to a different conclusion,—a conclusion which is, in effect, that few indeed of those which come out are ever able to, or at least seldom really do, straggle back.

During the time referred to I determined to see, if possible, the extent of the mortality among the earth-worms. So I took the opportunity of counting, as I walked slowly along, the number upon the ground, alive or dead. This I did in several places and under different circumstances.

The first place examined was a gravel walk in the Smithsonian grounds, while the rain was still falling. In a distance roughly estimated at 425 feet, I noticed 380 worms. Probably three-fourths of these were dead, lying drowned in pools of water, or else crushed by the feet of passers-by. On another path in the Smithsonian grounds were some very large examples, one of which was at least nine inches in length and as large round as an ordinary lead pencil. I have since seen specimens even larger than this.

A second place examined was on the asphalt sidewalk of Massachusetts avenue, between Fourteenth and Fifteenth, a distance of about 600 feet, and after the rain had ceased. In this distance I counted 180 worms, the dead ones averaging nine out of every ten. On one side of this stretch is a stone wall, generally with a considerable amount of dirt at its base, and on the

¹ Read before the Biological Society of Washington, April 20, 1889.

other side is a narrow strip of soil. The worms were counted as I walked slowly along, and it is most probable that all were not observed.

A third place was in Franklin Park, between Thirteenth and Fourteenth and K and L streets. Crossing this diagonally about half way, and noting the worms, not on the asphalt walk but on the little strips of gravel alongside, seldom more than twelve or eighteen inches wide, I counted 325 worms. Very few of these were alive. It was sprinkling slightly at the time and the ground was wet. Many lay in puddles of water where they had been drowned. During a rain of the following week I noticed the worms in the same place again, this time not so numerous. But the strip of gravel was marked all over by the trails left by the crawling creatures.

A fourth locality, and one seemingly very favorable to the existence or appearance of the worms, was on Fifteenth street, just north of Rhode Island avenue. The sidewalk was brick, and at one side was an open lot used as a tennis court. In a distance estimated at 200 feet I counted no less than 340 worms. They lay in the cracks between the bricks, on the bricks themselves, and in little pools of water. I doubt if there were a dozen alive out of the 340.

These four places were by no means the only ones where the worms were seen. On the roads and paths in the neighborhood of the Smithsonian and National Museum, on Fourteenth street, on Thirteenth street, on Massachusetts avenue, where there was a brick pavement, they were equally numerous. As before stated I had previously seen them in the Capitol grounds and other places in the Northeast.

There are two points of interest connected with this subject. One is the extraordinary abundance of the worms, and the other is their excessive mortality. We have, of course, no way of knowing positively the number of these creatures to each square yard or square foot of surface. Darwin, quoting Henson, says (*Formation of Mould*, pp. 158, 159), that there are in England about 53,767 to an acre: that he has seen 64 burrows in $14\frac{1}{2}$ square feet, or 9 in 2 square feet. Further, that in a cake of

dry earth as large as his two hands, there were seven burrows as large as goose quills (p. 160). If the numbers observed here above the surface are any good index to those below, their total number must be simply enormous.

The mortality among the worms, as shown by the number of dead ones, is immense. Taking the number as given above for a single acre—53,767—we find there are five to every four square feet, or $1\frac{1}{4}$ for every square foot of surface. Calculating the area observed in Franklin Square and the number there seen, we find one worm for every one and a half square feet. In the same way the number seen on Fifteenth street was one to every five and a half square feet, and in the Smithsonian grounds one in every nine square feet of surface. It should be remembered that the larger part of these were dead, and if, as in the case of Franklin park, one for every one and a half square feet out of a possible five in every four square feet die, it is easily seen that the mortality is enormous. If this proportion holds out in any way at all over the two hundred and seventy and odd miles of streets in Washington, what an epidemic among the worms there must have been during the three-days rain referred to.

Again, what is the cause of the mortality? We cannot say they are crushed by the feet of pedestrians, because many of them show no signs of injury. It would seem as if, attracted to the surface by the moisture, they crawl out upon the hard asphalt or gravel, and then finding it impossible to return to Mother Earth, die on account of exposure, or are drowned in the deluge of water, many meeting death in the last form.